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(54) APPARATUS FOR MEASURING THE WEIGHT OF RAILWAY VEHICLES

(71) We, TOKYO SHIBAURA DENKI KABUSHIKI KAISHA, a Japanese Company, of 72, Horikawa-Cho, Saiwai-Ku, Kawasaki-Shi, Kanagawa-Ken, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improved apparatus for measuring the weight of a railway vehicle such as a freight car, and more particularly to weight measuring apparatus utilizing load cells mounted on a supporting frame to be mounted on rails.

The freight charges of goods transported by freight cars are calculated in accordance with the actual weights or indicated weights of the goods. However, the weights of such goods having indefinite shape as wood, gravel or the like are generally weighed while they are loaded on freight cars together with the weights thereof. It is important to accurately measure the weights of respective freight cars hauled by a locomotive for the purpose of planning a running programme of a goods train.

Such method of measuring the weight of a freight car loaded with commercial goods is important from the standpoints of not only economy but also safe running of the train, and such method and apparatus of measuring should be simple and able to measure the weight accurately with only a small error.

According to this invention there is provided apparatus for measuring the weight of a railway vehicle having wheels with flanges, the vehicle being movable on rails of a railway wherein the rails have bottom flanges and upper heads, said apparatus comprising a supporting frame mountable on the bottom flanges between the rails, and a pair of load cells respectively mounted on the frame near the opposite ends thereof to lie alongside the upper heads of the rails, the load cells being mounted on the frame so that the wheel flanges may ride directly on the load cells.

The invention will now be further described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic side view of prior art apparatus for measuring the weight of a railway vehicle;

Figure 2*a* is a front view, partly in section, of another prior art apparatus for measuring the weight of a railway vehicle;

Figure 2*b* is a side view, of the apparatus shown in Figure 2*a*;

Figure 3 is a front view, partly in section, of still another prior art apparatus for measuring the weight of a railway vehicle;

Figure 4 is a front view of the novel apparatus for measuring the weight of a railway vehicle embodying the invention;

Figure 5 is a perspective view of the apparatus shown in Figure 4;

Figure 6 is a side view of the apparatus shown in Figure 4;

Figure 7 is a perspective view of a load cell utilized in this invention;

Figure 8 is a block diagram showing the electrical connection of the measuring apparatus; and

Figure 9 is a front view of a modified measuring apparatus embodying the invention.

Typical conventional apparatus for measuring the weight of a freight car is diagrammatically shown in Figure 1 wherein suitable lengths of existing rails 1 are cut and load cells 3 responsive to pressure are mounted at the bottom of a pit 2 formed beneath the cut length of the rails 5. A pressure receiving plate 4 is mounted on the load cells 3 and the cut length of the rails 5 are mounted on the pressure receiving plate 4 to be flush with the remaining portions of the rails 1. When a freight car 6 rides on the cut length of the rails, its weight is measured by the outputs of the load cells 3.

However, such weight measuring apparatus is bulky and expensive because it is necessary to cut the rails and dig a pit. The most serious defect of such apparatus is that the location of the apparatus is fixed so that it is necessary to move the car to

the apparatus when it is desired to measure the weight of the car. However, there are many occasions where it is desired to measure the weight of the car at any desired location such as at a terminal of a service line in a woodland. The prior art apparatus shown in Figure 1 is not suitable for such applications from the standpoint of economy. In certain cases, ambient conditions do not permit installation of such weight measuring apparatus. Even in large railway stations, the shunting operation necessary for bringing a particular car to the measuring apparatus requires a great deal of labour and time.

Figures 2*a* and 2*b* show another example of prior art apparatus for measuring the weight of cars in which blocks of load cells 9 including strain resistors 8 bonded to one side are secured to the side surfaces of existing rails 1 by means of bolts 10 and fixtures 11 so that the treads 7*a* of the wheels 7 ride on the blocks so as to measure the weight of a car. The wheel of a freight car generally comprises a tread 7*a* and a flange 7*b* on the outside of the tread as shown in Figures 2*a* and 2*b*, the tread having an inclination of about 1:20. For this reason, when the treads ride on load cells 9 the load cells will be loaded unequally due to such inclined treads, thus decreasing the accuracy of measurement. In addition, the fixtures 11 will be subjected to oblique forces due to uneven distribution of the weight of the car on the load cells, thus damaging the bolts 10 and fixtures 11 due to accumulated mechanical stresses.

Depending upon ambient conditions prevailing at a place in which the measuring apparatus is installed the bottom portions of the existing rails are often buried in mud, snow or gravel so that it is necessary to remove such obstacles, thereby necessitating constant maintenance.

In still another prior art weight measuring apparatus shown in Figure 3, a load cell 9 is mounted on the upper surface of an existing rail 1 by means of bolts 10 and a fixture 11 such that the tread 7*a* of a wheel 7 rides on the load cell 9. With this construction, since the load cell 9 is sandwiched between the rail and the tread of the wheel, the load cell is more stable than in the construction shown in Figures 2*a* and 2*b* and can be held in position by a smaller clamping force thus simplifying the construction and mounting of the load cell. Furthermore, as the upper surface of the rail is generally free from any obstacles it is easy to install the load cell. However, with this construction too, the load cell is subjected to an uneven load because it is ridden by the tread, thus decreasing the measuring accuracy. Where the rail has been used for a long period the upper surface is worn and has an inwardly inclined surface. Where the load cell is mounted on such inclined surface the load cell will also incline as it is subjected to uneven load. This not only reduces the accuracy of measurement but also renders unstable the mounting of the load cell. Consequently, when ridden by the car the load cell may become dismounted thus causing a risk of disrailment.

Moreover, when the load cell is mounted on the rail it is necessary to apply a large hauling power to the freight car to cause it to ride on the load cell.

Accordingly, it is an object of this invention to provide a simple apparatus for measuring the weight of a railway vehicle which can be readily installed at any desired location without reconstructing existing railway lines.

Another object of this invention is to provide an improved apparatus for measuring the weight of a railway vehicle which can be readily mounted and dismounted and which is stable in the installed condition thus enabling to measure the weight at high accuracies.

Still another object of this invention is to provide improved apparatus for measuring the weight of a railway vehicle which can be readily and stably mounted even on worn and deformed rails to provide accurate measurements.

A further object of this invention is to provide improved apparatus for measuring the weight of a railway vehicle which does not require a large hauling power to cause the vehicle to ride on the measuring apparatus.

A preferred embodiment of the present invention is shown in Figures 4 to 6. In this embodiment spaced rails 12*a* and 12*b* are mounted on sleepers 14 laid on a bed 13, and the apparatus comprises supporting frames 15*a* and 15*b* with their outer ends resting on the bottom flanges 16*a* and 16*b* of the rails 12*a* and 12*b* and their inner ends 17*a* and 17*b* interconnected by connecting bars 18 which are spaced vertically from the upper surfaces of the sleepers 14. The connecting bars 18 may be connected to the inner ends of the supporting frames by bolts or other suitable fastening means to form an assembly of a definite width.

Near the outer ends of the supporting frames 15*a* and 15*b* are mounted load cells 19*a* and 19*b* along the inner sides of the heads of the rails for measuring the weight of a car. As shown in Figure 7, each load cell is shown as comprising an iron block 20 provided with side grooves 21 and strain gauges 22 bonded to the bottom surfaces of the grooves 21. The blocks 20 are secured to the supporting frames 15*a* and 15*b* by welding, bolts or other fastening means at

positions corresponding to the flanges 25*a* and 25*b* of the wheels 24*a* and 24*b* of a freight car whose weight is to be measured. The blocks 20 are secured with their upper surfaces 23 faced upwardly to act as pressure receiving surfaces. On both sides of each load cell are mounted triangular guide pieces 26 on the rails for the purpose of causing the flanges of the wheels to ride on the load cells. When the flanges ride on the load cells, the rolling of the wheels can be prevented by using wedges 27. In Figure 6 are shown a plurality of load cells 19*a* to be ridden by the fore and aft wheels of a truck 33 of the car.

To use the weight measuring device described above, the assembly is transported to any desired position along the railroad and then mounted on the rails by merely resting the outer ends of the supporting frames 15*a* and 15*b* on the bottom flanges 16*a* and 16*b* of the rails. Then a car to be weighed is hauled until the flanges thereof ride on the load cells. Then, the strain gauges 22 are elongated or contracted in accordance with the weight of the car to produce electric signals. As shown in Figure 8, these output signals are added to each other by means of an adder 28 and the sum is displayed by a weight indicator 30 after passing through an amplifier 29. Loads exceeding a predetermined weight may be displayed by means of an acoustic alarm 31 or a lamp 32.

Although in Figure 6, two pairs of load cells are provided for measuring the weights of the fore wheels and aft wheels of a truck; where the distance between the fore and aft wheels varies from one car to the other, only one pair of load cells is provided whereby the weight of the fore wheels is firstly measured, then the weight of the rear wheels is measured and the sum of the measured weights is used to display the weight of a car.

Where it is desired to transport the measuring apparatus to another place, the assembly as a whole, or after disassembling, is transported to such place.

As can be noted from the foregoing description, the invention provides novel apparatus for readily and accurately measuring the weight of railway cars without reconstructing existing railway lines. As the weight of the car is measured by placing the flanges of the wheels on the load cells it is possible to apply equal and stable loads on the load cells thereby assuring high measuring accuracies. Furthermore, the measuring apparatus can be readily mounted on and dismounted from the rails without using any fixtures. Since the assembly of the measuring apparatus is mounted on the bottom flanges of the rails, even when the top surfaces of the rails are worn or deformed, and it is possible to maintain the connecting bars 18 in the horizontal position, equal load is applied on the load cells on both sides thereby providing high measuring accuracies. Further, it is possible to transport the measuring apparatus to any desired position.

As the load cells are carried by supporting frames the height of the load cells projecting above the upper surfaces of the rails is smaller than that of the prior art construction in which the load cells are mounted on the rails as shown in Figure 3. This decreases the hauling power required to cause the wheels to ride on the load cells. If the thickness of the supporting frames is decreased to bring the upper surface of the load cell to the same level or to a level lower than the upper surface of the rail the hauling power can be decreased further.

It is also possible to fabricate the guide pieces 26 to be integral with the supporting frames 15*a* and 15*b*. Furthermore, the blocks of the load cells can be formed to be integral with the supporting frames.

In a modification shown in Figure 9, left and righthand spporting frames 15*a* and 15*b* shown in Figure 4 are combined into a unitary structure 15.

WHAT WE CLAIM IS:—

1. Apparatus for measuring the weight of a railway vehicle having wheels with flanges, the vehicle being movable on rails of a railway wherein the rails have bottom flanges and upper heads, said apparatus comprising a supporting frame mountable on the bottom flanges between the rails, and a pair of load cells respectively mounted on the frame near the opposite ends thereof to lie alongside the upper heads of the rails, the load cells being mounted on the frame so that the wheel flanges may ride directly on the load cells.

2. Apparatus according to claim 1, wherein said supporting frame comprises a pair of end members to be mounted on the bottom flanges of the rails and a connecting member interconnecting said end members.

3. Apparatus according to claim 1 or claim 2, wherein two pairs of load cells are provided with a spacing corresponding to the spacing between the fore and aft wheels of a vehicle so that the fore and aft wheels simultaneously ride on said two pairs of load cells.

4. Apparatus according to claim 1 or claim 2, wherein a pair of load cells are provided such that the fore and aft wheels of a truck of the vehicle alternately ride on said pair of load cells.

5. Apparatus according to any one of claims 1 to 4, which further comprises guide

pieces to be mounted on the rails adjacent said load cells for guiding the wheels of the vehicle on to the load cells.

6. Apparatus according to any one of claims 1 to 5, which further comprises wedges utilized to anchor the wheels at the measuring position.

7. Apparatus for measuring the weight of a railway vehicle, substantially as hereinbefore described and as shown in Figures 4 to 9 of the accompanying drawings.

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1463958 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

FIG. 1 PRIOR ART

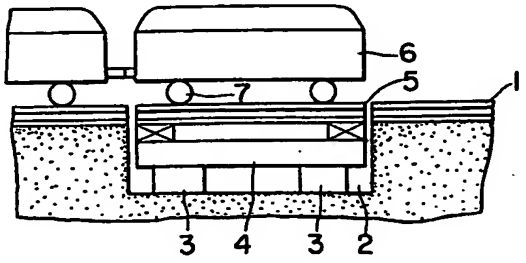


FIG. 2a PRIOR ART

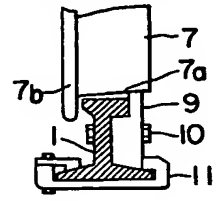


FIG. 2b PRIOR ART

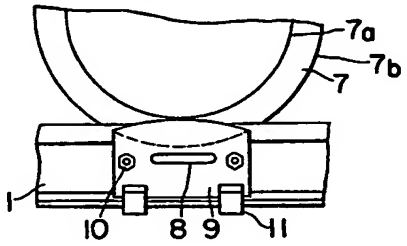


FIG. 3 PRIOR ART

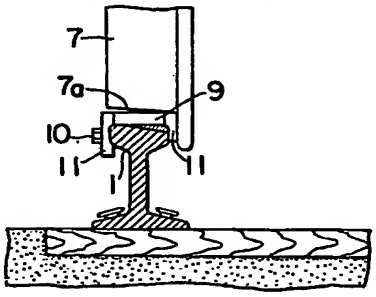


FIG. 4

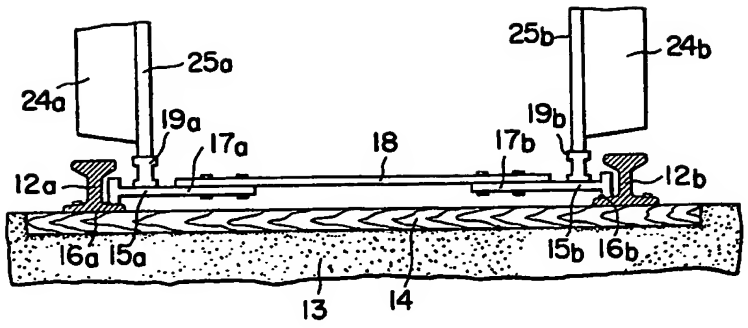


FIG. 5

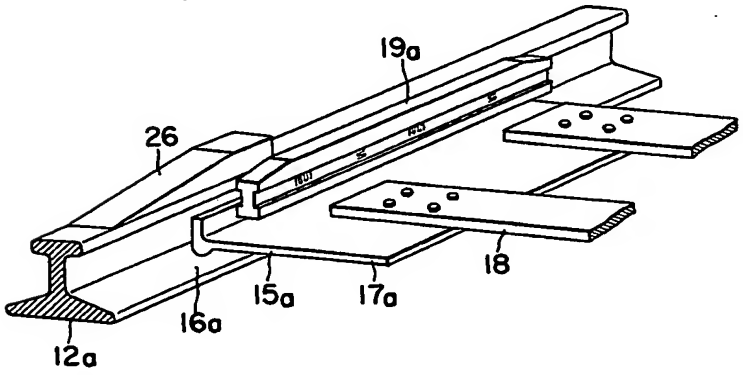
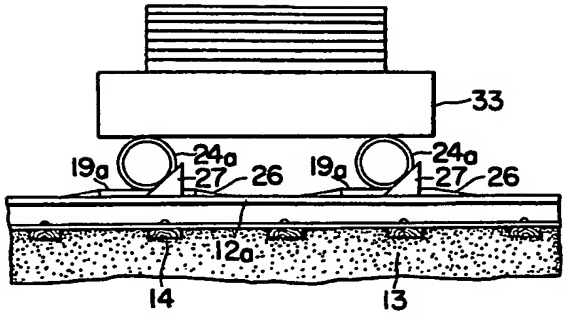


FIG. 6



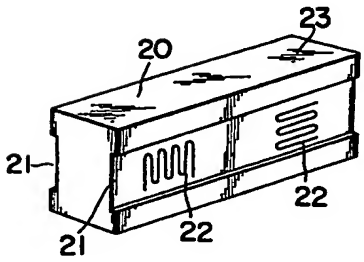


FIG. 7

FIG. 8

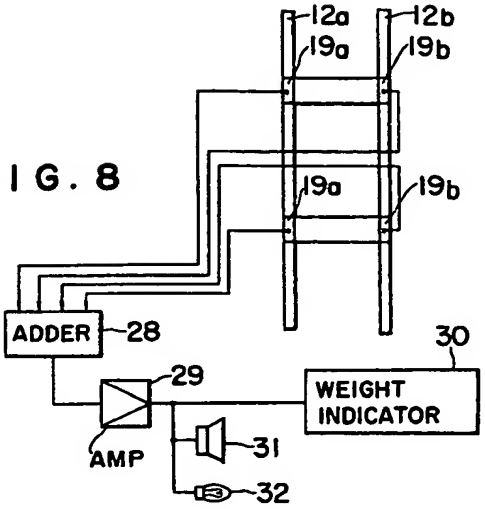


FIG. 9